NOTES ON AUSTRALIAN LAND-PLANARIANS, WITH DESCRIPTIONS OF SOME NEW SPECIES. Part I.

By J. J. Fletcher and A. G. Hamilton.

(Plate v).

This paper is a preliminary one inasmuch as it does not deal with the anatomical characters of Australian Land-Planarians. This is intentionally the case because to have rendered this part of the subject at all complete would necessarily have delayed its publication, whereas we are anxious to profit by the eminently favourable season for acquiring additional material. Owing to the prolonged damp weather land-planarians are more than usually abundant this year, and by calling the attention of members of this Society living in country districts to this fact, and offering a *résumé* of what is known of this much-neglected group, we hope that some of the more local species which are in danger of extermination, may be obtained for examination and description.

During the voyage of H.M.S. 'Beagle' Mr. Darwin collected Land-Planarians at the various places visited, and among them a species from Tasmania. A general account of them is given in "The Voyage of a Naturalist" (p. 26), and they were subsequently described in the "Annals and Mag. of Nat. Hist." (Vol. XIV. 1884, p. 244), the Tasmanian species under the name *Planaria Tasmaniana*.

Mr. Moseley likewise during the voyage of H.M.S. 'Challenger' assiduously collected Land-planarians as opportunity offered, three species being obtained from the neighbourhood of Parramatta and Camden, N.S.W. These were afterwards described (Quart. Jour. Micro. Sc. 1877, p. 285), a new genus *Cænoplana* being instituted for them.

These four species, we believe, include all the Australian Land-planarians at present described.

For some time past we have, both jointly and independently, collected planarians from the neighbourhoods in which we reside, and from such places as we have been able to visit during vacations. In this way we have obtained specimens from various places in the County of Cumberland, from the Blue Mountains as at Springwood (1,200 ft.) Hartley Vale and Mount Wilson (3,400), from near Capertee (2,600 ft.), and in the Capertee Valley, from various localities in the Mudgee District where one of us is resident, and from Burrawang (2,000 ft.). Though we have been able to go further afield than Mr. Moseley's short visit permitted him to do, yet relatively to the area which planarians may reasonably be supposed to inhabit even supposing this to be chiefly the coastal districts, we have, after all, only been able to glean in a few places. Nevertheless we have now obtained sufficient material to enable us to describe a number of new species, to announce the occurrence of a second genus characterised by the possession of two eyes, hitherto unrecorded from Australia, and to adduce reasons for merging the genus *Cœnoplana* of Moseley in *Geoplana*, F. Müll. In addition the Hon. William Macleay has kindly allowed us to examine the planarians in his Museum ; Mr. Olliff has given us specimens of two species from the Hunter River district, and Mr. Froggatt specimens of another species from Victoria, so that we are able to add some particulars about geographical distribution. Finally we have to thank Mr. Masters for a quantity of material obtained from one of the Sydney nurseries.

Of the sixteen species of which we have now examined examples, not one of them can be referred to the genus *Cœnoplana* of Moseley. Six of them are characterised by the possession of two instead of many eyes, and, pending histological examination to which we have not yet been able to attend, they are referred to the genus *Rhynchodemus* of Leidy. The other ten may be referred to the genus *Geoplana* as at present defined.

Eight of these are new, but the remaining two species agree so well as regards their external characters with the descriptions of *Cœnoplana cærulea* and *C. subviridis* of Moseley, except in the matter of eyes on the anterior extremity, that we cannot but think that they are identical with them, but that Mr. Moseley, possibly from an insufficient or indifferent supply of material, or from the study only of spirit specimens overlooked the presence of eyes on the anterior extremity. That Mr. Moseley had too much to occupy his attention during his short stay here to permit of studying the Australian planarians in the living condition is very probable from the fact that, in the same volume of the Journal which contains the paper already referred to, there is an earlier one, "On the Colouring Matters of Various Animals, and especially of Deep-Sea Forms dredged by H.M.S. Challenger" (*op. cit.* p. 11) in which the following passage occurs: "At Parramatta, near Sydney, N.S.W., two large species of *Rhynchodemus* are tolerably common, one of which is of a uniform Prussian blue colour, whilst the other is a uniform red." From this passage it would appear that when this earlier paper was written Mr. Moseley had investigated only the colouring matters of the Australian planarians, otherwise he would not, even provisionally, have referred these two many-eyed species to a genus characterised by the possession of two eyes; the descriptions of Australian planarians were thus probably drawn up at a later period, and therefore from spirit specimens. This being so, we can from our own experience with spirit specimens readily understand how the oversight might have occurred; as though we have spirit specimens of some species in which the eyes on the anterior extremity are perfectly visible with a lens, we have others in which without having seen living or better preserved specimens should be very sorry to be obliged to give a decision on this point.

In his description of the Tasmanian form Mr. Darwin says: "ocelli scattered round the entire margin of the foot, but most frequent at the anterior extremity." In his description of *Cœnoplana* Mr. Moseley says: "eyes absent from the front of the anterior extremity, but present in lateral elongate crowded patches

placed just behind the anterior extremity and scattered sparsely on the lateral margins of the body for its entire extent." Accordingly in the list of the known genera and species of land-planarians given in Mr. Moseley's valuable paper, he places the planarian described by Darwin among the species of *Geoplana*, with the remark that "this (species) will possibly prove allied to the Australian genus *Cœnoplana*." Further in the same paper in his description of *Geoplana Traversii* from New Zealand Mr. Moseley says: "numerous eye-spots are present; these are placed in a single row composed of twelve or more along the front margin of the head and in an elongate patch on either side of the head made up of two or three rows placed one above another and containing about forty eye-spots. Eye-spots are further scattered more sparsely on the lateral margins of the body, along its entire length posteriorly to this patch." Now in all our species with numerous eyes this is substantially the condition that we meet with. Thus in a young specimen of one of our species, *G. 5-lineata*, shortly after its emergence from the cocoon, and when it measured about 4 mm. long and 1 mm. broad, it was easy to count all the eyes, of which there were about 40 in each of the crowded patches, two, three or even four deep, and these were connected anteriorly by a single closely set row of about 16, of which 7 were on the very tip of the anterior extremity; posterior to the patches there were about 20 on each side scattered at more or less considerable intervals (1). The total number of eyes, as well as the numbers of eyes and of rows of them in the crowded patches vary with the the size of the animal, and appear not to be of specific importance. They are very numerous in the adults of this species, which sometimes show six or seven or even more rows of eye-spots in the crowded patches extending upwards on to the

(1) The actual number of eyes that can be counted just on the tip itself varies of course with the amount of contraction of the body; when fully extended the anterior extremity of even a large planarian will hardly if at all exceed 1 mm. in width, and then there may be only from three to five eyes in this space.

dorsal surface and lying dorsad of the outermost dorsal stripe. The eyes are readily discernible with a lens both in living and usually in well-preserved specimens of most of the species; in the blue-tipped variety of *G. cærulea*, and in *G. rubicunda*, however, they are more difficult to make out even in living specimens, though under a low objective they can be seen to have the usual arrangement. In *G. rubicunda* the eyes are more inconspicuous, smaller, and in the crowded patches in the specimen examined only about two rows deep. In the other species it is the dark colour of the back-ground which makes it difficult to see them.

If our supposition be correct that Professor Moseley from the examination of indifferent spirit material overlooked the presence of eyes on the anterior extremity of the Australian land-planarians examined by him, it seems unnecessary, in the present state of our knowledge, to separate these forms as a distinct genus *Cœnoplana* on purely anatomical grounds (the arrangement of the muscles, and of the lateral organs). No doubt eventually it will be found necessary to take anatomical characters into account in defining the genera, and in establishing his two new genera *Cœnoplana* and *Dolichoplana* Mr. Moseley did so. But we cannot find such definitions of *Geoplana* and *Rhynchodemus*. Moreover, the genus *Geoplana* already comprises 28 species (26 of which are enumerated in Moseley's Catalogue, with *G. Whartoni*, Gulliver, from the Island of Rodriguez, and *G. Moseleyi*, Hutton, from N. Zealand, since described) whereas the anatomy of only about two species is satisfactorily known (1). Under these circumstances therefore, and as all the many-eyed Australian species we have met with

(1) Speaking of the whole family Mr. Moseley says: "Of the *Geoplanidæ* the complete anatomy including that of the generative organs is known as yet only in the case of certain species of *Rhynchodemus* and *Bipalium* from Ceylon, and in *Geoplana Traversii* of New Zealand. The arrangement of the muscles and of the lateral organs (nervous systems or primitive vascular systems?) of the *Rhynchodemus* of the Cape, of a *Geoplana* of Brazil, of the Australian *Cœnoplanas*, and Manilla *Dolichoplanas* has been determined, and it appears that the *Geoplanidæ* form a very natural family" (l.c. p. 291).

may be referred to the genus *Geoplana* as at present defined, we venture to express the opinion that the retention of *Cœnoplana* is unnecessary.

Of the habits of Australian planarians we have as yet been able to learn very little. Thirty years ago Fritz Müller, writing to Schultze about Brazilian planarians, says : " They like moderately moist places, under wood, bark, and stones, and between leaves of the Bromeliaceæ. They appear to rest by day, and to crawl about during the night." (1) Omitting the reference to the Bromeliaceæ these remarks are applicable to Australian planarians, and we have little to add to them. Mr. Moseley, both in Ceylon and in Brazil, found planarians under fallen leaves and resting beneath the sheathing leaves of the banana plants ; in Brazil also crawling on palm stems in the daytime in very rainy weather, but in places where there was very little light; at the Cape on American Agaves ; and in Australia " they were found during the day coiled up in cavities under fallen logs, and at night observed with a lantern, crawling on the trunks of Eucalypts, especially about wounds from which sap was exuding." Most of our specimens have been obtained by turning over logs, pieces of wood and bark, and stones, when the planarians were found either on the ground, or adhering to the undersurface of the logs, &c., sometimes in the cracks and crevices even of charred logs. Once at Mt. Wilson towards the close of a wet day we discovered a specimen of *G. cærulea* crawling across the road. On another occasion we found a specimen crawling on a dead tree under loose bark ; several times crawling over stones in damp weather, and in one case a specimen of *G. viridis* on a blade of grass exposed to sunshine ; but we have not yet met with them abroad at night.

In dry weather they probably burrow in the ground. We have frequently found them in the soil, and at first in trying to keep living ones in confinement one of us tried placing them in inverted

(1) Abhand. der Naturf. Gesell. in Halle, Vol. IV, 1857. Translated in Ann. Mag. Nat. Hist. (2), xx, 1857, p. 3.

glasses pressed down on earth in flower-pots, from which at night-time they invariably escaped without difficulty by burrowing.

The situations in which we have found them are various. On the Blue Mts., at Mt. Wilson (3,400 ft. above the sea), as well as near Guntawang, we have found them on the tops of ridges, on the slopes leading down to gullies, and in the gullies; on the banks of the Cudgegong River, and on the edges of swamps; frequently on the edges of clearings, on lightly timbered land, or in scrub land; but we do not know yet whether they live in the thick brushes, where if they do occur the sheathing fronds of ferns like *Platycerium*, or *Asplenium nidus* might furnish them with resting places. On the summits and slopes of the ridges and in the more open gullies where there is no vegetation of this sort but only the ordinary forest trees and scrub, they seem to adopt themselves to circumstances and manage very well without it.

Some of the species are pretty widely distributed, one extending to Queensland and another to Victoria; others as far as we know at present are very local. We have not had them from further inland than the Mudgee district on the other side of the Dividing Range, and we should be glad to know if they are to be found in the interior. From the County of Cumberland we have obtained specimens belonging to six species, all occurring elsewhere; from Springwood six species, of which one *G. rubicunda* has not been found by us elsewhere, but there are some examples of it in the material given us by Mr. Masters; from Hartley Vale six species, three of which are local; from Mt. Wilson six species of which one has been found nowhere else; and in the Mudgee district seven species of which three are local. Individually, except in favoured localities or under very favourable circumstances, planarians cannot be said to be very abundant, and it usually involves a considerable expenditure of time and trouble to obtain many specimens. Nevertheless, in the Mudgee district one of us believes that he could sometimes have obtained a hundred specimens without much trouble. Elsewhere however, we have had to be content with a dozen specimens for a day's work. But, as a

rule, our experience is that, anywhere where logs and pieces of wood are plentiful, provided there is moisture, one may expect to find them.

Of the nature of their food we know absolutely nothing. Darwin was of opinion that the planarians he observed were vegetable feeders and fed on rotten wood. Schultze and Moseley, however, doubt this, and believe them to be carnivorous, the former having found the palate and jaws of a snail in the alimentary canal of a planarian which he examined. Fritz Müller also describes a species, *G. subterranea*, which lives in company with a species of earthworm and he says, . . . "the earthworms are devoured, or rather sucked by the planarians. That this was the mode of nourishment, was easy to see, from the colour of the contents of the intestine. But I have also met with *Geoplanæ* which were holding a young *Lumbricus* with their protruded probosces, and whose intestines were beginning to be filled with fresh blood" (l.c. p. 6).

It is quite possible that the nature of the food may be different in different species. If ours are carnivorous it is difficult to understand what animals furnish them with food, as often no traces of earthworms or snails are seen where planarians occur, though both may sometimes be found. On the other hand planarians are certainly to be found under logs which are not rotten, and in gardens and bush-houses where there is a scarcity of rotten wood in the immediate vicinity, so that one is led to wonder whether, like earthworms, they are able to extract nutriment from the soil.

But whether Darwin's opinion be correct or not, we know of no better plan than his of keeping these creatures in confinement, namely, of putting them in a tin or jar with damp rotten wood, and not unnecessarily exposing them to the light. At the present time we have several specimens which have been kept in this way for from one to nearly two months, and which seem none the worse for it. Possibly, as has been suggested to us, under these circumstances they may obtain some nutriment from Myxomycetes which probably develop in the damp wood.

Those belonging to the genus *Rhynchodemus* seem to be much more delicate than the species of *Geoplana;* it is much more difficult to keep them alive for any length of time, and even when handled in the most careful manner, using a feather in moving them, they frequently break up into pieces in the most provoking manner when touched, or on exposure to the light during examination, while in dealing with the species of *Geoplana* we have had little or no trouble. Though they evidently dislike exposure to strong light, yet sometimes when the tin in which we keep them has been incautiously left uncovered for a short time they have braved the consequences in their efforts to escape. Some have got right away, while others were found by following up their slimy tracks, a few feet off, dried up on the table partly through the dust on it.

We know nothing definite concerning the enemies whose attacks they have to withstand. In turning over logs in search of planarians, one cannot help noticing the numbers of centipedes, scorpions, spiders, ants, and predaceous beetles which are exposed to view, and of suspecting some or all of them of being at enmity with the planarians.

Nearly all our species of *Geoplana,* like many found elsewhere, are conspicuously marked, and some of them brightly and variously coloured. Thus one is blue with a white stripe, two are red, one is grass-green with reddish stripes, another bright yellow with dark stripes, and so on. This is the more remarkable in that they are essentially nocturnal animals. Darwin himself points out that in the case of hermaphrodite creatures such as planarians "the colours do not serve as a sexual attraction, and have not been acquired through sexual selection" (Descent of Man, p. 260). Nor, avoiding the light as they habitually do, is it clear how their colours can be of use to them as a protection either by assimilating them to the colour of their surroundings, or as in the case of gaudy caterpillars by serving as a warning to their enemies that they are distasteful, or that they are provided with defensive structures in the shape of urticating organs (rod cells). On the

other hand all the Australian species characterised by the possession of two eyes are dull-coloured and very inconspicuous, yet they live under similar conditions, and in similar and often in the same situations as the many-eyed species of *Geoplana;* we have found examples of both genera under the same log.

The anterior portion of the body when the animal is crawling, is raised from the surface on which the animal rests, and its under surface is distinctly arched or concave; in some of them from the edges of the concave portion sensory, papilla-like prolongations are frequently put forth, which touch the surface on which the animal is crawling, just as is the case with the inferior margin of the cheese-cutter-shaped extremity of *Bipalium.* In spirit specimens the arching disappears, but the margins of the under surface then show a slight but noticeable ridge on each side of a different colour; we hope later to investigate these structures by means of sections.

Mr. Moseley was the first to describe the cocoons or egg-capsules of land-planarians, which were previously unknown, from specimens brought to him by Mr. Travers of Wellington, N.Z., during the first week of July. His description of them is, "they were perfectly spherical and varied in diameter from 6mm. to $4\frac{1}{2}$ mm., being as large as an ordinary pea. Their walls were firm and resistant, and of very dark brown or almost black colour. The walls are composed of a thin continuous sheet of a dark brown chitinous substance, which is highly elastic, and rolls up into scrolls when torn into fragments. The brown substance shows no definite structure, but only fine granules partly scattered evenly through a homogeneous base, partly gathered into patches in it. The egg capsules were found to contain from 4 to 6 embryos which lay quite free within the cavities of the capsules and closely packed together, being curved up to accommodate themselves to confinement" (l.c. p. 279).

Australian land-planarians also breed during the winter months, and fabricate similar cocoons. Thus we have met with cocoons from the first week in April up till the present time (end of June). Some of these were deposited by specimens living in confinement, but quite recently one of us in

the Mudgee district on one occasion found a cluster of ten under a piece of wood, and on another occasion twenty-four cocoons from all but one of which however the young had hatched. These were the capsules of *G. quinquelineata*, the only species of which we have yet seen the newly-hatched young, but we have a few cocoons of other species which are still under observation. The cocoons met with vary slightly in size and shape; usually they are spherical, and 3 or 4 mm. in diameter; others have one axis longer than the other, about 5 × 3 mm. When freshly deposited they are yellow or orange-coloured, but in the course of a day or two the colour changes to a dark reddish-brown or even black. The number of young which come out of a cocoon is about three or four. In two instances the young hatched out in five weeks or a day or two longer, after the deposition of the cocoons. The latter usually rupture and when empty collapse, but in one case the young emerged from a small circular hole without the cocoon rupturing or collapsing. Sometimes the cocoon ruptures a few days before the animals leave it; at other times they come out very soon after. The newly-hatched young of *G. quinquelineata*, vary slightly in size, from 2·5 to 4 mm. long and 1·5 mm. wide, or even longer when fully extended; they are striped just as are the adults, except that the outermost stripe on each side is either very faint, or altogether absent; both stripes and ground-colour are in some cases brighter and pinker than is usually the case in adults, but the colours are extremely variable in this species, though it is perfectly well characterized, by its five dorsal, linear stripes. As yet we have not met with the young ones of any other species.

In addition to the sexual mode of reproduction, planarians frequently divide spontaneously by transverse fission into portions which are capable of acquiring the characters of complete animals. Mr. Darwin gives an interesting account of an experiment he made with one of the Tasmanian planarians, which he cut into two nearly equal halves; these, in the course of twenty-five days, were all but indistinguishable, when the increased heat on approaching the equator put a stop to his observations (Voy. of a

Nat. p. 27). We have frequently noticed specimens in various stages of constriction, and after the division had taken place.

The volume of the Journal containing Mr. Moseley's paper is, at the present time, wanting in most of the scientific libraries in Sydney accessible to students, and quite beyond the reach of any one in the bush. We, ourselves, have found it a serious inconvenience to have to journey to the Public Library to consult it, instead of having it always at hand for reference. In what follows, therefore, we have included the descriptions of Mr. Darwin and Professor Moseley, partly for the sake of making the list complete, but chiefly because we hope to enlist the co-operation of some of our country members in collecting and observing these interesting animals, as the species are readily determinable from the descriptions. Such large tracts of country have now been, and are being yearly cleared and burnt over, a procedure which means extermination to animals of feeble locomotive powers, like planarians, that unless residents in the country help in this matter it is almost certain that some of the more local species will never otherwise be rescued from oblivion. Insects, land mollusca, and other terrestrial invertebrates have been collected from very early times in the history of the colony, and before whole districts had been more or less completely modified by the clearing of the land, and the wholesale destruction of the timber; but this is not the case with planarians. The northern coastal river districts of this colony especially will probably yield a very rich harvest to any one in a position to search for them systematically. We shall be glad therefore to receive any information on the subject, or specimens sent alive by post, or put while alive into good methylated spirit (1).

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(1) In sending living planarians by post, as we find by experience can be done, the best plan is to put them in a small (not too small however) tin box with a geranium leaf and a small piece of damp cotton-wool or moss, fixed under the leaf so as not to shake about. A piece of paper should be pasted round the edge of the lid, otherwise, as they can flatten themselves in an astonishing manner, the planarians are apt to escape.

GEOPLANA (altered from Stimpson).

"Corpus depressum, vel depressiusculum, elongatum vel lineare, capite continuo. Ocelli numerosi, marginales, vel submarginales; vel in parte anteriori corporis solum, vel passim circa corpus, singulatim plerumque, nonnunquam in acervos dispositi" (1).

1. Geoplana Tasmaniana, Darwin.

Planaria Tasmaniana, Darwin, Ann. Mag. Nat. Hist., 1844, xiv, p. 246; *Geoplana Tasmaniana*, Schultze l.c. p. 7; *G. Tasmaniana*, Moseley. l.c. p. 289.

"Mouth-sucker widely extensile: alimentary orifice placed nearly in centre of the body; genital orifice $\frac{1}{10}$ inch posteriorly, but when the animal crawls it is $\frac{2}{10}$ inch distant. Genital orifice very distinct submargined. Ocelli scattered round the entire margin of the foot, but most frequent at the anterior extremity. Both extremities pointed. Colour dirty honey-yellow with a central dark brown line bordered on each side with a broader line of pale umber-brown: foot quite white. Length when crawling $1\frac{5}{10}$, when contracted $\frac{8}{10}$ inch."

Hab.—Beneath decayed trees in the woods of Van Diemen's Land: frequent in February (Darwin).

2. Geoplana cærulea, Moseley.

(Plate v, fig. 1).

Cœnoplana cærulea, Moseley, Quart. Jour. Micro. Sc. 1877, p. 285.

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(1) Gulliver, Phil. Trans. Vol. 168, p. 562.

The following is Mr. Moseley's definition of the genus *Cœnoplana*:—

"Body long and worm-like, much rounded on the back, flattened on the under surface, without an ambulacral line; external longitudinal muscular bundles largely and evenly developed over both dorsal and ventral regions; lateral organs as in *Rhynchodemus*; eyes absent from the front of the anterior extremity, but present in two lateral elongate crowded patches placed just behind the anterior extremity, and scattered sparsely on the lateral margins of the body for its entire extent; mouth nearly central, pharynx cylindrical." *Hab.*—N.S.W.

" Entire body of a dark Prussian blue colour somewhat lighter on the under surface of the body and with a single, narrow, mesial, dorsal, longitudinal stripe of white. Length, 5 cm.; extreme breadth, 4 mm. Mouth central; generative aperture 8 mm. posterior to mouth " (Moseley).

Hab.—Sydney, Parramatta, Ryde, Springwood, Mt. Wilson, Hunter River, N.S.W.; Cairns, N. Queensland.

The specimens of this planarian that we usually find, when alive have the immediate anterior extremity for a short distance orange-red, darker towards the tip; in such cases the eyes are readily visible with a lens; the colour more or less completely disappears in spirit. Quite recently, however, on three different occasions we have found on the pavement in Hyde Park alongside the enclosure at Captain Cook's statue a number of blue planarians (about fourteen altogether), which are without the red tip, and in which the median stripe varies from a dirty white to a distinct yellow, changing to white in spirit. In these the eyes on the anterior extremity against the dark-blue background are only readily visible under a low objective, and in living specimens. The enclosure referred to has probably been stocked with these planarians from the Botanic Gardens, but we do not know from what locality. The differences in living specimens in the two cases seem to be constant, and are sufficiently marked to make one a variety of the other, if not to separate them as distinct species. In spirit specimens, however, the difference is sometimes imperceptible, and we do not know whether Mr. Moseley examined both or not. As Mr. Moseley does not mention the red tip, and we have not had the specimens without it (with a single exception among the material given us by Mr. Masters) from anywhere but the Park, we are not even sure which of them ought to be considered the typical form. From its common occurrence we should suppose the former, with the addition to the description of the reference to the brightly coloured anterior tip.

When alive and looked at from above in both cases two tints of blue are visible, just the lateral portions of the body being of a lighter colour.

The largest specimen we have had when alive and crawling was 11·5 cm. long. The Queensland specimens are in the Macleay Museum, and were collected by Mr. Froggatt, who, however, did not find any other species. Mr. Moseley's locality is "Parramatta, under the bark of a species of Eucalypt." The rest we have added.

3. Geoplana sanguinea, Moseley.

Cœnoplana sanguinea, Moseley, *op. cit.* p. 285.

"Closely resembles *G. cærulea*, with the exception that it is coloured of a uniform light red, which is lighter upon the under surface of the body. Actual length living, 7 cm.; breadth, 4 mm."

Hab.—"Parramatta, amongst earth at the roots of a Eucalyptus stump" (Moseley).

We have never met with an example of this species.

4. Geoplana subviridis, Moseley.

(Plate v, figs. 2 and 2′).

Cœnoplana subviridis, Moseley, *op. cit.* p. 285.

"Ground colour of the body greenish-yellow beneath. In mesial line of the dorsal surface is a broad band of the ground colour, bordered on either side by a somewhat narrower but very sharply defined intensely black band. Beyond the black bands externally on either hand lie bands of the ground colour of equal breadth to them; and beyond these again is a very broad band which extends outwards nearly to the lateral margin of the body, which band is composed of a shading of fine longitudinal streaks of reddish-brown, and is bordered on either side by a narrow, dark, nearly black margin, the inner border being more intensely pigmented of the two. The bands and lines become narrower and more indistinct towards the posterior extremity and eventually

blend. The immediate anterior extremity of the animal is of a bright burnt sienna colour, darker towards the tip. Length of largest specimen when living and crawling, 16 cm.; breadth, 4 mm.; length of smaller specimen when crawling, 12·5 cm." (Moseley).

Hab.—Parramatta and Camden (*Moseley*), Seven Hills, Hunter River, Hartley Vale, Mullamuddy near Mudgee.

Mr. Moseley says of his specimens "under dead logs, and on bark of Eucalypts." We have had specimens both larger and smaller than those mentioned above; the largest 20 cm. long, when living and extended.

5. Geoplana variegata, n. sp.

(Plate v, figs. 3 and 3′).

Undersurface white or cream-coloured in the centre, changing to greenish-yellow at the margins. In the median line of the dorsal surface is a very narrow linear longitudinal stripe of pale yellow or greenish-yellow, bordered on either side by a slightly wider but still narrow linear stripe of dark brown or greenish-brown, its inner margin the straighter and better defined; external to each of which again is a stripe of pale or greenish-yellow, twice or three times the width of the median one; these in turn are each bounded externally by a very broad band extending outwards nearly to the lateral margin of the body, which band consists of an inner very dark and well-defined portion in width about $\frac{1}{3}$ of the whole, an outer marginal portion well defined but less intensely coloured, and an intermediate portion consisting of numberless fine irregular wavy lines and streaks, with blotches and patches of the yellowish ground colour shewing through; beyond each of the broad bands is a narrow band of pale or greenish yellow. The median stripe, except for a short anterior portion where its bounding lines fuse, is very well defined throughout; its bordering dark lines are lost quite anteriorly in the red or bright sienna colour of the extreme tip, while just posteriorly they become confluent with the corresponding dark bands.

Length of largest specimen when living and crawling 17 cm.; breadth 5 mm.; the same in spirit 13·8 cm. long, 7 mm. broad; length of smaller specimen 2·6 cm., breadth 2 mm.; we have had various intermediate sizes. In a specimen 7·5 cm. long the oral aperture is 25 mm. behind the anterior extremity, and the generative aperture 13 mm. posterior to the mouth.

It is difficult to express accurately the exact tints of the dark bands in living specimens; they appear of various shades of brown yet tinged with dark green; sometimes they are almost sage green. In spirit specimens all the yellow and green tints are lost; the ground colour becomes whitish or cream colour, and the dark bands various shades of brown.

Hab.—County of Cumberland, Springwood, Mt. Wilson, Hartley Vale, Capertee, Burrawang.

This fine species resembles *C. subviridis* in the general character of the markings, but differs in their arrangement, the narrow median stripe with its narrow bordering dark stripes in the one case, markedly contrasting with the broad median stripe with its intensely dark and relatively broader stripes in the other. The new species has also the dark inner margin of the broad bands wider.

6. Geoplana sulphureus, n. sp.

Ground colour above and below of a uniformly bright gamboge-yellow. In the median dorsal line a narrow band of ground colour bordered on either side by a dark reddish-brown line as wide as the median stripe; external to each of them is a band of ground colour about as wide as the median stripe and its two dark bounding lines taken together; beyond which again on either side is an intensely black band, about as wide as the stripe of ground colour which it bounds externally: the bands become more or less confluent just at the posterior extremity, while just anteriorly they are obscured by the orange-red tint which colours

the anterior extremity. In spirit the ground colour is discharged and imparted to the spirit, but the dark stripes remain. Length of two spirit specimens 32 and 40 mm., 3 mm. wide.

Hab.—Mt. Wilson, Hartley Vale, N.S.W.

7. Geoplana quinquelineata, n. sp.

(Plate v, figs. 4, 5, 15, 16).

Undersurface whitish. Ground colour above presents considerable variations, pale yellow or nearly orange, dull olive-green, ochreous-brown, reddish-brown, sometimes almost brick-red. The dorsal surface divided into six longitudinal bands by five longitudinal lines, also varying in colour, sometimes a darker and more intense tint of the ground colour, from dark brown almost black to warm brown or red, their margins irregular when viewed with a lens, arranged as follows: usually a very fine dark line occupies the median line, external to which on each side is a narrow band of ground colour; outside of which again on either side is a line of brown or red usually slightly broader and better defined than the mesial line; each of these again is bordered by a band of ground colour one and a-half times or twice as wide as the inner stripe on each side; beyond each of which is the outermost brown or red line of the same width as the first on each side but sometimes narrower, and each of these is followed by a narrow band of ground colour extending outwards to the lateral margin of the body. At the anterior extremity the lines blend in the red tip. The ground colour, and the reddish tint of the anterior extremity usually disappear more or less completely in spirit, while the bands become brown or sometimes black.

Largest living specimen 10 cm. long. In two contracted spirit specimens 42 and 23 mm. long respectively, the apertures of the mouth are 20 and 12 mm. respectively behind the anterior extremity; in a third specimen 26 mm. long the genital orifice is 4 mm. anterior to the hinder extremity. In none of our specimens are both apertures visible.

Young specimens on emerging from the cocoon are 2·5 to 4 mm. long. In these and sometimes in larger ones the colour of the anterior portion of the body is more intense. In very young specimens also the lines are brighter, but the outermost one on each side is only faintly indicated, or absent.

Hab.—Near Parramatta, near Springwood, near Capertee, Guntawang, Beaudesert Hills, Biraganbil Hills, N.S.W.; Sandhurst, Victoria.

This is one of our commonest species, and notwithstanding the variations in the tints it is easily recognised by the five linear stripes. At present we are unable to distinguish varieties, or more than one species by definable characters, but when we have been able more systematically to compare adults and young ones from various localities it may be possible to do so. For three Victoria specimens we are indebted to Mr. Froggatt. They resemble some of our N.S. Wales examples in having the ground colour rather dark both above and below, and in having the median line as broad as the others, and more intensely coloured, almost black.

8. Geoplana viridis, n. sp.

(Plate v, figs. 6, 13, 14).

Ground colour below pale greenish-yellow or in some specimens pinkish; above bright grass-green. In the mesial line of the dorsal surface is a fairly broad band of ground colour bounded on either side by a fine line of bright burnt sienna; external to which on either side is another band of ground colour about of equal width with the mesial band; beyond each of these again another sienna line sometimes consisting of separate dots of pigment, so that these lines as compared with the inner ones are not so intense in colour or are even broken; external to each of them is another band of ground colour extending outwards to the lateral margin of the body, slightly narrower than the median band. The lines converge slightly towards the centre, and those of each side become confluent just at the anterior extremity, and of a slightly brighter colour, and

the two patches thus formed also become continuous across the back for a short distance just behind the row of eyes. The tip not otherwise sienna-coloured. The median green stripe continues nearly to the tip.

Length of largest living specimen 11·19 cm. long; 1 cm. wide; largest spirit specimen 7·5 cm. long, 6·5 mm. wide; mouth posterior to anterior extremity 3·5 cm.; genital orifice behind mouth 12 mm.

Some spirit specimens retain the colour fairly well, but it is usually more or less completely taken up by the spirit; the lines fade considerably.

Hab.—Guntawang, N.S.W.

From the banks of an anabranch of the Cudgegong River.

We have a number of specimens answering to the above description; in addition we have met with two variations. Firstly, we have a few specimens in which the outer sienna line on each side is wanting. Secondly, we have a few specimens in which the ground colour is pale greenish-yellow, with two or four sienna lines. Some of these however, may be only immature specimens, as the few young ones so far met with are pale yellow or pale greenish above, and have the two inner stripes complete and distinct only anteriorly, while posteriorly they, as well as the outer lines when present, are broken and indistinct.

9. Geoplana ornata, n. sp.

(Plate v. fig. 7).

Undersurface very pale yellowish. Ground colour of dorsal surface pale sienna. A median dorsal well-defined line of a darker shade of the ground colour, in some cases and in some portions of its course apparently double when viewed with a lens; beyond it on each side a wide band of ground colour marked with short longitudinal stripes of a darker tint, and bordered externally by a

somewhat interrupted line of the same width and tint as the median stripe; beyond which again is a narrow band of ground colour of a paler shade sometimes bordered externally by an interrupted line like that previously mentioned, extending outwards to the lateral margin of the body; the sides of the body a paler shade of ground-colour marked with darker dots. Except that of the undersurface, the colours are fairly well retained in spirit specimens.

A living specimen alive and extended 5·5 cm. long, 3 mm. broad.

Hab.—Hartley Vale, N.S.W.

10. Geoplana virgata, n. sp.

Undersurface pale brownish yellow. A narrow median longitudinal stripe of umber; on each side of which lies a band of a lighter tint, and of about twice or thrice the width, marked with narrow broken longitudinal lines, and bounded externally by a darker broken line; outside the latter on either side a narrow band of pale brown free from longitudinal markings, and bounded externally by another darker broken line, outside which again is a band marked with short fine longitudinal markings.

Crawling and extended about 2·5 cm. long, 3 mm. wide.

Hab.—Hartley Vale.

From under logs on a swampy flat.

11. Geoplana munda, n. sp.

(Plate v. fig. 8).

Undersurface greyish in centre, yellowish towards the margins. Above there is a narrow median dorsal line of pale olive-brown, bounded on either side by a very fine dark line, external to which is a broader band of a slightly darker brown, and this is bordered externally by a very dark brown line which gradually merges into a rather broad band of very dark brown which fades gradually towards it outer margin.

This pretty little planarian retains its colours in spirit very well but the undersurface becomes quite white. The single specimen

obtained measured when alive and crawling, 2·5 cm. long, and 3 mm. broad. In spirit it measures 15 mm. long, 4 mm. broad, the mouth 6 mm. behind the anterior extremity, and the generative aperture 2 mm. behind the mouth.

Hab.—Hartley Vale.

From under a log and almost in the water on a swampy flat.

12. Geoplana rubicunda, n. sp.

Body tapering gradually anteriorly, more abruptly posteriorly, convex dorsally, flat ventrally (or somewhat concave in the median line), thin, much depressed, contrasting markedly with *G. cærulea* in this respect. Dorsal surface of a bright brick-red, somewhat darker in the anterior portion of the body and in the median line, otherwise fairly uniform; no indication of any stripes; undersurface of a lighter tint; in spirit the colours fade considerably. Eyes smaller and more difficult to make out than usual.

Length of a living specimen extended 60 mm., breadth 2 mm.; the same specimen in spirit 38 mm. long, 3·5 wide, aperture of mouth not visible, the genital aperture 28 mm. behind the anterior extremity; length of a second (spirit) specimen 52 mm., breadth 3·5 mm., the mouth 32 mm. behind the anterior extremity, and the genital aperture 7 mm. behind the mouth.

Six other spirit specimens from 4-9·5 cm. long, and 3-6·5 mm. wide; in three of them 9·5, 6·9, and 6·5 cm. long respectively, the oral apertures are 6·5, 4·2, and 4 cm. respectively behind the anterior extremity, while the generative apertures are 8·5, 6·5, and 6 mm. respectively still further back.

Hab.—(Sydney), Springwood, N.S.W.

The six specimens above-mentioned were among a number of planarians obtained at one of the Sydney nurseries, and given to us by Mr. Masters. When previously referred to (*antea* p. 245) we thought they were possibly not indigenous. They appear however to belong to the same species as two subsequently found in a gully at Springwood. Like these they have the body relatively broad and depressed (very noticeable in the largest specimens), and the oral aperture further back than usual. They

have lost the red tint, and are fulvous. More or less of the undersurface in all the specimens is concave in the median line, but this may perhaps be due to contraction, though we have not noticed a similar effect in other species.

We do not think this can be Moseley's *G. sanguinea*, as it cannot be said to closely resemble *G. cærulea*, the body being more depressed, and the oral aperture further back than in that species.

Genus RHYNCHODEMUS.

Rhynchodemus, Leidy, Proc. Acad. Nat. Sc. Philad. v, 1851.

"Corpus elongatum, sub-depressum, antrorsum attenuatum, utrinque obtusum. Ocelli duo subterminales."

13. Rhynchodemus Moseleyi, n. sp.

(Plate v. figs. 9 and 10).

Undersurface whitish. Entire upper surface dark olive-green almost black. A very narrow mesial dorsal black line bounded on either side by a much wider stripe of ground colour; external to each of these stripes a black line slightly broader than the median one, beyond which again the ground colour extends to the lateral margin of the body. The ground colour is so dark that that the longitudinal lines are difficult to detect.

Length living 3·3 cm. long, 3 mm. broad.

Hab.—Beaudesert Hills, Guntawang, N.S.W.

14. Rhynchodemus Coxii, n. sp.

Above shining black with two narrow longitudinal azure-blue lines enclosing a very narrow median longitudinal stripe of the ground colour; viewed with a lens the ground colour is seen to be dotted with minute azure-blue specks, while the azure lines have their margins ill-defined and somewhat irregular, and appear as if dotted with black; the lines continue right to the posterior extremity, but begin some little way behind the anterior one which is not coloured reddish. In spirit the lines become white.

Undersurface much lighter in colour and showing two whitish lines, one on either side of the oral and genital orifices. Length crawling 33 mm.

Hab.—Mt. Wilson.

We are glad to associate this pretty little species with the name of our friend, Mr. J. D. Cox, who found the only specimen yet seen, and to whom we owe the opportunities we have had of visiting Mt. Wilson, and whose enthusiastic help in looking for Planarians we gratefully acknowledge. The specimen lived only for a few days and died unexpectedly before its examination was complete, the anterior extremity breaking off, so that we do not yet know the characters of its eyes. It may therefore be a species of *Geoplana*, but as we cannot see any eyes in the portion of it now in spirit, it is provisionally placed here, until we can obtain fresh examples.

15. Rhynchodemus obscurus, n. sp.

Undersurface almost white. Dorsal surface shining, dark ashy-grey shading to black, darkest in small specimens, lighter in very large specimens in which the colour is slightly darker in the anterior portion of the body; with a more or less distinct median darker longitudinal line; the lateral margins of the body much lighter, gradually shading into the white of the undersurface. In spirit the colour changes to dull drab. When quiescent the body is relatively broad and flattened; when fully extended it is quite slender, and then the posterior extremity is more pointed than the anterior one. No ambulacral line, the animal using the whole undersurface as a sole.

Length of two of the largest specimens alive and extended 8 cm. and 5·4 cm. respectively, 3 and 2 mm. broad; the former in spirit 39 mm. long, 3 mm. broad; a smaller specimen alive and crawling 3·8 cm. long, 2 mm. broad; in spirit 18 mm. long, 3 mm. broad, the mouth 11 mm. behind the anterior extremity, and the generative aperture 4 mm. posterior to the mouth.

Hab.—Ryde; near Springwood; near Guntawang, N.S.W.

16. Rhynchodemus guttatus, n. sp.

Undersurface much spotted irregularly with numerous small blackish dots on a whitish ground. In the median line of the dorsal surface is a very narrow jet black stripe bordered on either side by a slightly wider but narrow white linear stripe sparingly dotted here and there with minute black spots visible with a lens; external to each of these again is a broad band of shining black, towards and at the extremities much broken up into numberless small black spots and blotches; beyond each of these is a narrow lighter blotched band on the side of the body. The margins of all the bands and stripes somewhat ragged: the white stripes disappear near the extremities.

Two specimens alive and extended 4 cm. and 2 cm. long respectively, 2 mm. broad; the former in spirit is 14·5 mm. long, 3 mm. broad, the mouth 8 mm. behind the anterior extremity, the genital orifice 3 mm. posterior to the mouth.

Hab.—Springwood, N.S.W.

We have twice seen at Mt. Wilson what we believe to be a specimen of this species, but on both occasions it disappeared before it could be examined. Another specimen sent us by Mr. Cox is damaged, and we are therefore doubtful about their identity. The white stripes at once distinguish this species from any of the others.

17. Rhynchodemus trilineatus, n. sp.

(Plate v. figs. 11 and 12).

Undersurface whitish flecked with black spots. The dorsal surface with a broad shining dark purplish-brown almost black band, which shows a median, and on each side a marginal, linear longitudinal black stripe; beyond which on each side a narrow lighter band, the lines of demarcation formed by the marginal stripes very conspicuous, and anteriorly at the level of the eyes. Length crawling and extended 3 cm., broad 2 mm.

Hab.—Guntawang.

18. Rhynchodemus niger, n. sp.

Dorsal surface shining intense black; sides and undersurface black (fading to violet in spirit) but less intense, and duller, or the undersurface black with a faintly indicated lighter stripe on either side of the median line.

Length of a living extended specimen 35 mm., breadth 2·5 mm.

Hab.—Guntawang.

EXPLANATION OF PLATE V.

All the figures are of the natural size and from living specimens unless otherwise stated.

Fig. 1.—*Geoplana cærulea* (blue-tipped variety).
Fig. 2.—*G. subviridis*, from a small spirit specimen.
Fig. 2.′— ,, ,, (enlarged diagram shewing the pattern of the stripes).
Fig. 3.—*G. variegata*, from a small extended living specimen.
Fig. 3.′— ,, ,, (diagram shewing the pattern of the stripes).
Fig. 4.—*G. quinquelata*, from a very large living specimen.
Fig. 5.— ,, ,, from a small spirit specimen.
Fig. 6.—*G. viridis.*
Fig. 7.—*G. ornata.*
Fig 8.—*G. munda.*
Fig. 9.—*Rhynchodemus Moseleyi.*
Fig. 10.— ,, ,, anterior extremity (×2).
Fig. 11.—*R. trilineatus.*
Fig. 12.— ,, ,, anterior extremity (×5).
Fig. 13.—*G. viridis*, anterior extremity of spirit specimen shewing the eyes (×2).
Fig. 14.—*G. viridis*, anterior extremity of young specimen with fewer eyes (×2).
Fig. 15.—*G. quinquelineata*, anterior extremity (×5).
Fig. 16.— ,, ,, anterior extremity of young specimen with fewer eyes (×5).

Note.—Fig. 1 is too black; in fig. 7 the lithographer has filled in a portion of the marginal stripe on each side with transverse lines instead of dots; in fig. 8 the median stripe is too light; in fig. 15 the rows of eyes in the crowded patch are too regular.